

13281 U.S. PTO  
010504

1     **ROTATABLE CUTTING TOOL FOR BREAKING HARD MATERIAL**  
2     **BACKGROUND OF THE INVENTION**

3     1. Field of the Invention

4             The present invention relates to a rotatable cutting tool, and more  
5     particularly to a cutting tool with a hard cutting bit insert mounted in a tool  
6     holder in a rotatable drum to break a hard surface into pieces.

7     2. Description of Related Art

8             Road planers are used to remove pavement and prepare roads for  
9     resurfacing by grinding the pavement into pieces. With reference to Figs. 4 to 6,  
10    a road planer (not shown) uses a rotatable drum (50) with multiple rotatable  
11    cutting tools (60) to break up and grind down a hard surface layer such as asphalt  
12    pavement. The rotatable drum (50) comprises multiple tool holders (61). Each of  
13    the tool holders (61) has a cylindrical hole (611) to hold a cutting tool (60). Each  
14    of the cutting tools (60) is held by the tool holder (61) and rotated by the  
15    rotatable drum (50) to break up and grind down the hard surface layer. The  
16    cylindrical hole (611) has an inside wall (not numbered).

17            The cutting tool (60) comprises an elongated tool body (62), a hard  
18    cutting bit insert (63) and a resilient retainer (64). The tool body (62) is normally  
19    cylindrical, is held in the cylindrical hole (611) by the resilient retainer (64) and  
20    has an inner end (not numbered), an outer end (not numbered) and an annular  
21    recess (not numbered). The resilient retainer (64) is mounted in the annular  
22    recess. The inner end of the tool body (62) is inserted into the cylindrical hole  
23    (611) with the resilient retainer (64) that expands against the inside wall of the  
24    cylindrical hole (611) so that the tool holder (61) retains or holds the cutting tool

1 (60).

2 The outer end of the tool body (62) extends out of the hole (611). The  
3 cutting bit insert (63) is axially welded at the outer end of the tool body (62) and  
4 has a conical tip (not numbered) and a flat end (not numbered). The flat end is  
5 welded at the outer end of the tool body (62). The conical tip cuts a hard  
6 substance, such as asphalt, concrete or the like, on the road.

7 The tool body (62) is generally made of steel. The cutting bit insert (63)  
8 is generally made of a tungsten carbide alloy. To attach the cutting bit insert (63)  
9 to the tool body (62) by welding is not easy because they are made of different  
10 materials with different properties. Since the mechanical properties such as  
11 coefficients of expansion of the steel and the tungsten carbide alloy are different,  
12 heat generated by the operation of the cutting bit insert (63) breaking up the hard  
13 substances will effect the combination of the tool body (62) and the cutting bit  
14 insert (63). The tool body (62) and the cutting bit insert (63) expand at different  
15 rates as they heat up, which will stress the joint between the tool body (62) and  
16 the cutting bit insert (63) and cause the joint to fail.

17 The stress acting on the cutting bit insert (63) concentrates at the joint  
18 between the tool body (62) and the cutting bit insert (63). The heat and the stress  
19 will cause the cutting bit insert (63) to easily separate from the tool body (62)  
20 during the cutting operation.

21 With the cutting bit insert (63) broken off, the tool body (62) will  
22 directly impact the hard substances and be worn away by the hard surface. Since  
23 the tool body (62) is made of steel, the tool body (62) will be quickly worn away,  
24 and the tool holder (61) will be damaged or completely worn away. The damaged

1 tool holder (61) cannot hold a new cutting tool (60) and must be replaced, which  
2 requires much more time than replacing a cutting tool (60). Therefore, keeping  
3 the cutting bit insert (63) from separating from the tool body (62) is necessary to  
4 prevent damage to the tool holder (61).

5 To overcome the shortcomings, the present invention provides an  
6 improved cutting tool with an enhanced joint between the tool body and the  
7 cutting bit insert to mitigate or obviate the aforementioned problems.

#### 8 SUMMARY OF THE INVENTION

9 The main objective of the invention is to provide a cutting tool with a  
10 tool body, a cutting bit insert and an enhanced joint between the tool body and  
11 the cutting bit insert to keep the cutting bit insert from separating easily from the  
12 tool body.

13 To achieve the main objective, a rotatable cutting tool for applications  
14 such as road resurfacing work includes a cutting bit insert and a tool body. The  
15 cutting bit insert includes an insert body and an inner tiered protrusion integrally  
16 formed from the insert body. The inner tiered protrusion has multiple tiers that  
17 are parallel to one another. The tool body has a tiered recess that corresponds to  
18 the inner tiered protrusion to hold entirely the inner tiered protrusion. A joint  
19 between the inner tiered protrusion and the tiered recess provides a strong  
20 connection and keeps stress from concentrating at a single point.

21 Other objectives, advantages and novel features of the invention will  
22 become more apparent from the following detailed description when taken in  
23 conjunction with the accompanying drawings.

#### 24 BRIEF DESCRIPTION OF THE DRAWINGS

1            Fig. 1 is an operational side plan view in partial section of part of a  
2 rotatable drum with multiple tool holders and cutting tools in accordance with  
3 the present invention;

4            Fig. 2 is a side plan view in partial section of a cutting tool in Fig. 1;

5            Fig. 3 is an operational side plan view of the drum in Fig. 1;

6            Fig. 4 is an operational side plan view of part of a rotatable drum with  
7 multiple tool holders and conventional cutting tools in accordance with the prior  
8 art;

9            Fig. 5 is a side plan view in partial section of a conventional cutting tool  
10 in Fig. 4; and

11           Fig. 6 is an operational side plan view of the rotatable drum in Fig. 4.

## 12    DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

13           With reference to Figs. 1 and 2, a cutting tool in accordance with the  
14 present invention is mounted in a conventional tool holder (61) on a rotatable  
15 drum (50) to break a hard surface into pieces. The cutting tool comprises a  
16 cutting bit insert (10), a tool body (20) and a resilient retainer (64). The cutting  
17 bit insert (10) can be made of tungsten carbide alloy and comprises an insert  
18 body (12) and an inner tiered protrusion (11). The insert body (12) has a conical  
19 tip (not numbered) and an inner flat end (not numbered). The inner tiered  
20 protrusion (11) is integrally formed on the inner flat end. The inner tiered  
21 protrusion (11) comprises a proximal tier (not numbered) and a distal tier (not  
22 numbered). The proximal tier protrudes perpendicular from the inner flat end of  
23 the insert body (12) and has a top (not numbered). The distal tier protrudes  
24 perpendicular from the top of the proximal tier.

1           The tool body (20) has an inner end (not numbered), an outer end (not  
2           numbered), a tiered recess (21) and an annular recess (not numbered). The inner  
3           end of the tool body (20) is held in the tool holder (61) by the resilient retainer  
4           (64) that is attached to the tool body (20) by being mounted in the annular recess  
5           to hold the tool body (20) in position. The tiered recess (21) is defined in the  
6           outer end of the tool body (20) and corresponds to the inner tiered protrusion (11)  
7           and the inner flat end of the insert body (12).

8           The inner tiered protrusion (11) and the inner flat end of the insert body  
9           (12) are welded in the tiered recess (21) of the tool body (20) and form a joint  
10          (not numbered). Therefore, the inner tiered protrusion (11) and the tiered recess  
11          (21) have a larger contact area than a conventional tool body and cutting bit  
12          insert. Therefore, stress applied to the insert body (12) will be directed into both  
13          vertical and horizontal directions to diminish the stress on any single edge.  
14          Therefore, the cutting bit insert (10) is much more difficult to separate from the  
15          tool body (20) during a cutting operation.

16          With reference to Fig. 3, the tiered design of the joint between the cutting  
17          bit inset (10) and the tool body (20) provides a robust and strong connection. An  
18          insert body (12) may fracture internally if it encounters a particularly hard  
19          substance, but the inner tiered end of the insert body (12) should still be retained  
20          on the tool body (20) to prevent the tool body (20) from wearing away.

21          Even though numerous characteristics and advantages of the present  
22          invention have been set forth in the foregoing description, together with details  
23          of the structure and function of the invention, the disclosure is illustrative only,  
24          and changes may be made in detail, especially in matters of shape, size, and

- 1 arrangement of parts within the scope of the appended claims.